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EVALUATION OF BLAST FURNACE SLAG FOR POSSIBLE USE AS AN ADDITIVE TO MINE BACKFILL

FINAL REPORT

CONTRACT SERIAL NO.: 23440-6-9156/01-SQ

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68pp

MICROMEDIA

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1.0 EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

A so called "Round Robin" testing program was conducted in 1986 to evaluate ground granulated blast furnace slag (GGBFS) from Algoma Steel Corporation for possible use as an additive to mine backfill. The evaluation was based on compressive strength tests conducted at the laboratories of INCO Ltd., Falconbridge Ltd., Noranda Inc. - Geco Division, and Kidd Creek Mines Ltd., as well as at an independent laboratory.

The program described in this report is a continuation of the 1986 Round Robin program. As with the 1986 program, the objective of the continuation program was to evaluate GGBFS from the Reiss Lime Company of Canada for possible use as an additive to mine backfill. The participating mines were INCO Ltd., LAC Minerals Ltd. - Hemlo Division, Hemlo Gold Mines Inc., Denison Mines Limited, Teck Corona Operating Corporation, and Detour Lake Mines.

The results of the laboratory compressive strength tests indicate the Reiss GGBFS is potentially a suitable replacement for Portland cement in the applications tested for the participating mining companies. The test results are interpreted as justification for proceding with field testing to further evaluate the GGBFS.

2.0 INTRODUCTION

2.0 INTRODUCTION

The mining industry is potentially the largest market in Northern Ontario for cement manufactured using granulated slag from The Algoma Steel Corporation Ltd. in Sault Ste. Marie. Mining companies have traditionally used Portland cement for binding backfill materials, but the desire to reduce operating costs has prompted these companies to begin investigations into lower cost alternatives to Portland. In a project sponsored by Energy Mines and Resoures Canada in 1984, WATTS Cement Ltd. of Sault Ste. Marie undertook the task of installing a pilot slag granulation facility at Algoma Steel's #7 Blast Furnace and successfully produced slag cement samples suitable for evaluating ground slag as an additive to concrete. These samples were made available to several mining companies for incorporation into their programs to find a lower cost alternative to Portland.

Four mining companies, INCO Ltd., Falconbridge Ltd., Kidd Creek Ltd., and Noranda Inc. - Geco Division participated in a slag testing program partially funded by Energy, Mines and Resources Canada (EMR), with the objective of evaluating GGBFS produced from Algoma Steel as an additive to cemented mine backfill mixtures. Each mine conducted a series of compressive strength tests on several combinations of Portland cement, GGBFS and backfill material. INCO also investigated lime as an activating agent in mixtures containing GGBFS as the only binding material. The tests conducted by the mining companies were complemented by a series of similar tests at an independent laboratory.

The success of the tests conducted on the prototype GGBFS led to the construction of a full scale slag processing plant and slag grinding facility by The Reiss Lime Company of Canada Ltd. Both the slag processing plant located adjacent to #7 Blast Furnace, and the slag grinding plant located at Serpent Harbour on Reiss Lime's property have begun operation, and production GGBFS is now available.

The positive results of the pilot plant, compressive strength tests, and the recent availability of production plant GGBFS generated interest at many mining companies and other Portland cement users in Northern Ontario. Specifically, INCO Ltd., LAC Minerals Ltd. - Hemlo Division, Hemlo Gold Mines Inc., Denison Mines Limited, Teck Corona Operating Corporation, and Detour Lake Mines, expressed interest in having the Reiss GGBFS evaluated with their backfill materials.

3.0 TECHNICAL DISCUSSION

3.0 TECHNICAL DISCUSSION

3.1 General Scope

The research activities involved conducting unconfined compressive strength tests on cylinders prepared using varying proportions of Portland cement, GGBFS, lime, and mine backfill materials obtained from each of the mining companies participating in the test program. Test parameters and mix preparation procedures were unique for each mine because backfilling procedures vary from mine to mine. The compressive strength tests were conducted by Trow Ltd., at their Sudbury laboratory.

Mix preparation procedures are described in detail in the results section of this report (Section 4.0).

3.2 Test Parameters

3.2.1 INCO Limited

Binder Compositions:

Reiss Slag	Portland	Lime
100%	0%	0%
100%	0%	1%
100%	0%	5%
100%	0%	10%
0%	100%	0%

Lime addition measured as a percentage of Algoma slag, and displacing an equivalent weight of sand in the mix.

Binder Contents: Fill/binder ratios of 10/1, 20/1, and 30/1.

Fill: Garson sand.
Screen analysis of sand shown in Appendix 2 of Section 4.0 - Results.

Pulp Density: 68% solids.

Unconfined compressive strength testing on the mixes as follows:

Ages: 7, and 28 days.

Replicates: 5.

Cylinders: 6" X 12"

MIX AND CYLINDER SUMMARY: 15 MIXES
150 CYLINDERS

3.2.2 Denison Mines Limited

Binder Compositions:

Reiss Slag	Portland	Lime
100%	0%	0%
75%	25%	0%
50%	50%	0%
0%	100%	0%
100%	0%	1%
100%	0%	3%
100%	0%	5%

Lime addition measured as a percentage of Algoma slag, and displacing an equivalent weight of fill in the mix.

Binder Contents: 1. 25 MPa Denison Special Mix

Binder (kg)	Sand (kg)	3/4" Stone (kg)
375	906	906

Add water to obtain slump of 9 inches.

2. 35 MPa Shotcrete

Binder (kg)	Sand (kg)	3/8" Pea Gravel (kg)
490	1070	594

Add water to obtain slump of 10 inches.

NOTE: Ingredient weights proportioned for laboratory samples as required.

Admixtures: 6 hour retarder, 475ml/m3 of Daratard 17
Air entrainment of 2 OZs/m3 or 6%

Unconfined compressive strength testing on the mixes described as follows:

Ages: 7, 28, 60, 90, and 120 days.

Replicates: 3

Cylinders: 6" X 12"

MIX AND CYLINDER SUMMARY 14 MIXES
210 CYLINDERS

3.2.3 Lac Minerals Ltd. - Hemlo Division

Binder Composition:

Reiss Slag	Portland	Lime
100%	0%	0%
75%	25%	0%
50%	50%	0%
0%	100%	0%
100%	0%	1%
100%	0%	5%
100%	0%	10%

Lime addition measured as a percentage of total binder, and displaces an equivalent weight of fill material

Binder Content: 5% and 4% of the total fill weight

Fill: Screened gravel suitable for use in 6" X 12" cylinders supplied by Lac. The gravel was from the same pit as the rockfill used at the mine. Appendix 2 of the Trow report in Section 4.0 of this report shows the grain size analysis of the fill material used. (See Section 3.3 for rationale behind using substitute for the actual fill material).

Unconfined compressive strength testing on the mixes described will take place as follows:

Ages: 28, 56, and 85 days

Replicates: 3

Cylinders: 6" X 12"

MIX AND CYLINDER SUMMARY 14 MIXES
126 CYLINDERS

3.2.4 Hemlo Gold Mines Inc.

Binder Composition:

Reiss Slag	Portland	Lime
100%	0%	0%
75%	25%	0%
50%	50%	0%
0%	100%	0%
100%	0%	1%
100%	0%	5%
100%	0%	10%

Lime addition measured as a percentage of total binder, and displaces an equivalent weight of fill material

Binder Content: 5% and 4% of the total fill weight

Fill: Screened gravel suitable for use in 6" X 12" cylinders supplied by Hemlo. The gravel was from the same pit as the rockfill used at the mine. Appendix 2 of the Trow report in Section 4.0 of this report shows the grain size analysis of the fill material used. (See Section 3.3 for rationale behind using substitute for the actual fill material).

Unconfined compressive strength testing on the mixes described will take place as follows:

Ages: 28, 56, and 85 days

Replicates: 3

Cylinders: 6" X 12"

MIX AND CYLINDER SUMMARY 14 MIXES
126 CYLINDERS

3.2.5 Teck Corona Operating Corporation

Binder Ratios: binder/fill ratios of 1/6, 1/10, 1/20, and 1/30

Binder Types:

Slag Cement	Portland	Lime
100%	0%	0%
0%	100%	0%

Binder Ratios: Binder/fill ratios of 30/1

Binder Composition:

Reiss Slag	Portland	Lime
100%	0%	0%
0%	100%	0%
100%	0%	1%
100%	0%	3%
100%	0%	5%
100%	0%	7%

Fill: 70% sand/30% tails, provided by Teck. Sand, tails and fill characterization tests will include sieve analysis, dry bulk density, specific gravity, and standard tube percolation. Appendix 2 of the Trow report in Section 4.0 of this report shows the results of the material characterisation tests conducted.

Pulp Density: 70% Solids

Floculant: Percol E155, Allied Colloid added to all mixes at the rate of 30 grams per tonne of backfill to simulate mine conditions.

Unconfined compressive strength testing on the mixes described will take place as follows:

Ages: 7, 28, 56, and 90 days

Replicates: 3

Cylinders: 6" X 12"

MIX AND CYLINDER SUMMARY 12 MIXES
144 CYLINDERS

3.2.6 Detour Lake Mines

Binder Compositions:

Reiss Slag	Portland	Lime
100%	0%	0%
75%	25%	0%
0%	100%	0%
100%	0%	1%
100%	0%	3%
100%	0%	5%

Lime addition measured as a percentage of Reiss slag, and displacing an equivalent weight of sand in the mix.

Binder Contents: Fill/binder ratios of 10/1, and 20/1.

Fill: Pit sand.
Screen analysis of sand required

Pulp Density: 68% solids.

Unconfined compressive strength testing on the mixes described will take place as follows:

Ages: 7, and 28 days.

Replicates: 3.

Cylinders: 6" X 12"

MIX AND CYLINDER SUMMARY: 12 MIXES
72 CYLINDERS

3.3 Lac Minerals Ltd. and Hemlo Gold

The particle size distribution of the fill material used at two of the mining companies made laboratory tests using conventional 6" x 12" cylinders impractical if the actual fill material had been used. WATTS Cement learned the fill material used at Lac and Noranda - Hemlo is quarried surface granite, recovered such that one hundred per cent of the material will pass through a six inch screen. If the actual fill material had been used, some of the stone would have been as large as the diameter of the test cylinder and the results of the tests would not have been representative of underground conditions.

Two potential solutions to the problem of designing laboratory tests which are representative when the fill material contains very large particles were considered. One alternative was to increase the diameter of the test cylinders to accomodate the larger particles. In the case of six inch rock, the cylinders should be 18 to 24 inches in diameter. The second alternative was to produce a laboratory sample of fill material which had the same relative particle distribution as the actual material, but had a maximum particle size suitable for use with the conventional 6" x 12" cylinders.

The preferred and chosen solution was to design laboratory samples with a representative particle distribution. Most laboratories cannot test 18 or 24 inch diameter cylinders, and those who can charge very high prices, justified by the extra material handling, the need for specialized testing equipment, and the lack of competition. Also, several tons of fill material would be needed to prepare the large cylinders, making transportation costs very high. Transportation and laboratory testing costs were both minimized by designing and using a sample with a smaller maximum particle size because conventional laboratory testing equipment was used and far less material had to be shipped and handled.

Kidd Creek Mines Ltd. have studied the issue of using smaller maximum particle size material for laboratory tests and found that the strength of test cylinders are the same as the strength of core samples removed from actual backfilled areas. Since the rock fill used at Lac and at Noranda - Hemlo is similar to the fill used at Kidd Creek, the fill material used in the tests can also be similar.

4.0 RESULTS

Trow

MINE BACKFILL TESTING PROGRAM WITH REISS LIME SLAG CEMENT

PREPARED FOR:

WATTS CEMENT LIMITED

TROW ONTARIO LTD.
Toronto, Hamilton, London
Sudbury, North Bay, Ottawa

Project: S871427R
December 14, 1987

1074 Webbwood Drive
Sudbury, Ontario P3C 3B7
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Trow

Rock Mechanics
and
Mining Division

Trow Ontario Ltd.
Consulting Engineers
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Telephone: (705) 674-9681

S871427R

December 14, 1987

Watts Cement Limited
72 Mount Pleasant Court
Sault Ste. Marie, Ontario
P6A 6K4

ATTENTION: Mr. C. Kirkwood, P.Eng.
Project Manager

Dear Sirs:

MINE BACKFILL TESTING PROGRAM
WITH REISS LIME SLAG CEMENT

This report provides the results from the uniaxial compressive strength testing program carried out with various combinations and proportions of slag and/or portland cements, concrete aggregates, lime, mine tailings and rock fill materials. Backfill materials were gathered from Inco, Hemlo Gold, Teck Corona, Denison, Lac Minerals and Detour Lake. Hydraulic cementious slag was obtained from Watts Engineering. Portland cement used on this project was made by Lake Ontario Cement. The sample preparations and uniaxial compressive strength tests carried out in accordance with CSA testing procedures.

1.0 TERMS OF REFERENCE

The terms of reference for the testing program were to mix the cemented backfill samples and to establish the uniaxial compressive strength for each test cylinder. The mix designs were made with slag and portland cement in different proportions and various backfill materials as an aggregate. All test mixes were based on the batch preparation instructions supplied to Trow from Watts Engineering.

The uniaxial compressive strength of each mixture is given in imperial units (psi) with the exception of Denison Mines which was recorded in SI units (MPa). Test specimens were formed in a standard (6" X 12") cylinder mould.

The number of cylinders cast per mix varies, as does the duration vary of the curing period. A summary of compressive strength results is given in Appendix 1.

Five grain size analyses were performed on the materials used as aggregates and a percolation test was performed on a blended sample of material for Teck Corona. These results are reported in Appendix 2.

Mine tailings were delivered to us submerged in water to prevent oxidation prior to testing.

2.0 TESTING OUTLINE

The following section deals with specific test cylinder preparation and testing programmes used for each of the above noted mines.

2.1 Inco

- 10 cylinders were cast for each mix design
- 5 cylinders were tested at 7 days and 5 cylinders were tested at 28 days
- mix designs were based on 100% slag cement replacement with 0, 1, 5, 10% lime slurry as an activator - the lime slurry used was delivered to us by Inco

- total cement: Levack sand ratios were 10/1, 20/1 and 30/1
- a grain size analysis was performed on the Levack sand and is shown under Appendix 2.0 Backfill Characteristics Summary

2.1.1 Testing Program

- 6" x 12" cardboard moulds were used
- numerous 1/8" Ø holes were punched in the metal bottom of the moulds to allow the water to percolate through the tailings
- a cardboard collar of height of 6" was placed on top of the mould and taped in place to compensate for the settlement
- empty moulds were placed in a storage tank the bottom of which was perforated and covered with sand to allow water to percolate down through the cylinder and tank
- 12-18 hours prior to batching, the sand which was shippped to us in 45 gallon drums, was placed on the laboratory floor to air dry
- several hours before batching, 3 representaive moisture contents were taken for water content adjustment in design calculations
- design mix was then batched and the pH recorded
- the slurry of material was poured in the cylinders in three lifts to the top of the collar
- cylinders were allowed to set overnight in the storage tank after being covered with wet burlap sacks and plastic sheeting
- ±24 hours after casting the cylinders were removed from the tank and the collars removed and top of cylinders trimmed using a hacksaw
- a plastic bag is placed over each cylinder which was then placed in the moisture room with a constant 90-100% relative humidity

2.1.2 Cylinder Preparation and Testing

- cylinders were removed from curing room the day of testing
- cylinder mould was stripped down to the half way mark (6 inches)
- plastic 6" ABS collar was strapped in place so that about ¼" to ½" was above the existing cylinder
- the collar was checked for being square
- a 50/50 mixture of portland cement and quick dry plaster was in the collar and trowelled level
- after 5 minutes the same procedure was repeated on the other end
- cylinder was then weighed and placed in the testing apparatus
- proving ring was placed on top of the cylinder
- loading rate was 0.08 in/min. i.e., (strain controlled test) deflection readings were taken every 15 seconds until failure, type of break was recorded
- deflection reading at failure was converted to pounds per square inch

2.2 Hemlo Gold

- 9 cylinders were cast for each mix design
- 3 cylinders were tested at 28, 56 and 85 days
- mix designs were based on 100%, 75%, 50% and 0% slag cement replacement with 1, 5, 10% hydrated lime as an activator
- total cement: ~~binder~~ ratio was 4 and 5% by weight of mix (see technical discussio
- two grain size analyses were performed on a representative sample of the mine rock and the material as blended by Hemlo for use in this testing program. These results are shown under Appendix 2

2.2.1 Testing Program

- 6" x 12" moulds were used
- a layer ¼" to ½" thick of 3 sand to 1 portland cement was placed in the bottom of the mould 3 to 4 hours prior to casting of backfill mixture
- sand and gravel aggregates were placed on the floor 18 to 20 hrs. prior to batching and were allowed to air dry
- 3 representative samples of the sand and gravel were taken for water content adjustment in design caluclations
- design mix was then batched and the pH recorded
- the test batch was then thoroughly mixed and then placed in the mould in three lifts and each lift rodded 25 times using a standard slump cone steel rod
- the test batch was placed in the mould to a depth of ¼" to ½" below the top of the cylinder
- cylinders were then placed in the curing room without plastic bag covers
- curing room was kept at a constant 90-100% relative humidity

2.2.2 Cylinder Preparation and Testing

- after 4 days in the curing room, the top cap was placed on the cylinder using the 3 to 1 sand to portland cement ratio mix
- 7 days after casting the cylinders were cut open by slitting along both sides of the mould
- the cylinders were removed from the mould and returned to the curing room until the appropriate date for testing
- cylinders were removed from the curing room the day of testind and weighed and then placed in the testing machine
- proving ring was placed on top of the cylinder and deflection readings taken every 15 seconds until failure
- loading rate was constant at 0.08 in/min. (strain control test)
- deflection readings were then converted to psi
- type of break was recorded

2.3 Teck Corona

- 12 cylinders were cast for each mix
- 3 cylinders were tested at 7, 28, 56 and 90 days
- mix designs were based 0, 100% slag cement replacement with 0, 1, 3, 5 and 7% hydrated lime as an activator
- ~~total cement: binder~~ Fail to binder ratios are 6/1, 10/1, 20/1 and 30/1
- percol was added in a scaled down fashion to simulate 1.05 oz./ton as given to us by Watts Engineering

Laboratory analysis was performed on the sand and tailings in the form of:

1) grain size analyses were performed on the sand and tailings
2) rod dry density tests were performed on the sand and tailings
3) Bulk Relative Density and Apparent Relative Density tests were performed on the sand and tailings
4) a percolation test was carried out on a blended sample when mixed at a ratio of 30 lbs. tailings to 70 lbs. sand, (results given in Appendix 2)

2.3.1 Testing Program

The tesing program for Teck Corona was performed with the same procedures as subsection 2.1.1.

2.3.2 Cylinder Preparation and Testing

This section was carried out according to subsection 2.1.2 of this report.

2.4 Denison Mines

- 15 cylinders were cast for each mix design
- 3 cylinders were tested at 7, 28, 60, 90 and 120 days
- mix designs were based on 25 MPa special concrete mix and 35 MPa shotcrete mix design
- slag replacement was based on 100%, 75, 50, 0,
- 25 MPa mix consisted of a measured slump of 228 mm (see technical discussions for full description)
- 35 MPa mix consisted of a measured slump of 250 mm
- admixtures were added in a scaled down fashion to simulate
- 475 ml/m³ of Daratard 17 and 56 ml/m³ of air entrainment as given to us by Watts Engineering

2.4.1 Testing Program

- the sand and stone was shipped in 45 gal. drums
- sufficient water was added along with the admixtures to achieve the desired slump and air entrainment content as specified
- slump and air tests were performed on each batch to ensure a uniform mix
- cylinders were rodded 25 times in three equal lifts
- cylinders were allowed to cure on the laboratory floor for 24 hrs. with plastic bags over each cylinder
- after the initial curing period the cylinders were stripped, weighed, labelled and placed in the moisture room with a constant 90-100% relative humidity

2.4.2 Cylinder Preparation and Testing

- cylinders were removed from the curing room the day of testing
- cylinders were dried and capped using molten sulphur and fly ash compound
- after the caps have set for 2 hrs. the cylinders were then placed in the testing apparatus with a loading rate of 0.25 MPa/sec

- deflections readings were taken every 15 seconds until failure and type of break was recorded
- results were expressed in SI units (MPa)

2.5 Lac Minerals

- 9 cylinders were cast per mix design
- 3 cylinders were tested at 28, 56 and 85 days
- mix designs were based on 100, 75, 50, 0 percent slag cement replacement
- hydrated lime was added as an activator in proportions of 0, 1, 5, 10%
- ~~total~~ cement: blended sand and aggregate binder were established ~~at~~ 4 and 5% ratios Total Cement = 4% and 5% by weight of mix (see Technical Discussion)
- a grain size analysis was performed on the blended material and is shown under Appendix 2

2.5.1 Testing Program

The testing program for Lac Minerals was performed in the same procedures as subsection 2.2.1.

2.5.2 Cylinder Preparation and Testing

This section was carried out according to subsection 2.2.2 of of this report.

2.6 Detour Lake

- total of 6 cylinders were cast for each mix design
- 3 cylinders were tested at 7, 28 days
- mix designs were based on 100, 75, 0% slag cement replacement
- hydrated lime was added as an activator in proportions of 0, 1, 3, 5% based on the amount of binder of the mix
- ~~total~~ cement: Full to binder ratios were 10/1, 20/1 (see technical discussion)
- a grain size analysis was performed on the sand and is shown under Appendix 2

2.6.1 Testing Program

The testing program for Detour Lake was performed in the same procedures as subsection 2.1.1.

2.6.2 Cylinder Preparation and Testing

This section was carried out according to subsection 2.1.2 of this report.

Should you have any questions regarding these results, please do not hesitate to contact this office.

Yours very truly,
TROW ONTARIO LTD.

RJF:jak
Encl.

R.J. Ferguson, C.E.T.
Materials Manager

Trow

APPENDIX 1

Trow

INCO

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. #S871427P

Client: WATTS

Date of Report: October 20, 1987

Mine Location =====>INCO

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Slag	Composition (%) Type 10 Portland	Lime	Compressive Strength (p.s.i.)					Type of Fracture					pH of Mix	Unit Weight of Cylinder (pcf)	Remarks
	Mar 24	Apr 7	14	100	0	0	52	24	40	40	48	C	C	C	C	C	10.0	121/120/122/123/123	
	Mar 24	Apr 21	28	100	0	0	61	69	63	65	65	C	C	C	C	C	10.0	120/120/121/121/124	
	Mar 24	Apr 7	14	100	0	1	39	48	40	28	56	C	C	C	C	C	11.0	120/121/121/122/122	
	Mar 24	Apr 21	28	100	0	1	68	64	38	86	86	C	C	C	C	C	11.0	121/123/123/122/122	
	Mar 24	Apr 7	14	100	0	5	32	17	17	24	17	C	C	C	C	C	11.8	125/126/125/124/125	
	Mar 24	Apr 21	28	100	0	5	N/A	N/A	28	28	N/A	-	-	C	C	-	11.8	126/126/125/125/126	
I-4	Mar 24	Apr 7	14	100	0	10	39	32	24	32	40	C	C	C	C	C	12.5	125/126/125/125/125	
	Mar 24	Apr 21	28	100	0	10	43	27	32	31	42	C	C	C	C	C	12.5	124/125/125/124/125	
I-5	Mar 24	Apr 7	14	100	0	0	N/A	N/A	27	28	27	-	-	C	C	C	10.1	125/125/124/123/123	
	Mar 24	Apr 21	28	100	0	0	22	40	31	31	32	C	C	C	C	C	10.1	126/125/125/126/124	
I-6	Mar 25	Apr 8	14	100	0	1	9	9	N/A	N/A	N/A	C	C	-	-	-	10.6	125/126/125/125/124	
	Mar 25	Apr 22	28	100	0	1	30	24	28	25	29	C	C	C	C	C	10.6	121/122/123/123/121	

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes concial fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

...8714278

Client: WATTS

Date of Report: October 20, 1987

...location =====>INCO

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Slag	Composition (%) Type 10 Portland	Lime	Compressive Strength (p.s.i.)					Type of Fracture					pH of Mix	Unit Weight of Cylinder (pcf)	Remarks
	Mar 25	Apr 8	14	100	0	5	18	17	18	N/A	N/A	C	C	C	-	-	11.8	122/121/122/121/123	
	Mar 25	Apr 22	28	100	0	5	23	18	19	22	N/A	C	C	C	C	-	11.8	122/123/122/122/123	
	Mar 25	Apr 8	14	100	0	10	16	16	N/A	18	12	C	C	-	C	C	12.3	122/123/124/121/122	
	Mar 25	Apr 22	28	100	0	10	18	22	N/A	18	N/A	C	C	-	C	-	12.3	123/123/124/122/122	
	Mar 25	Apr 8	14	100	0	0	N/A	N/A	N/A	N/A	N/A	-	-	-	-	-	9.7	Weights Not Available	Samples Saturated
	Mar 25	Apr 22	28	100	0	0	18	N/A	20	19	N/A	C	-	C	C	-	9.7	123/122/123/124/125	
I-10	Mar 25	Apr 8	14	100	0	1	N/A	N/A	N/A	N/A	N/A	-	-	-	-	-	11.0	Weights Not Available	Samples Saturated
	Mar 25	Apr 22	28	100	0	1	20	21	18	18	12	C	C	C	C	C	11.0	122/121/123/124/125	
I-11	Mar 25	Apr 8	14	100	0	5	16	N/A	17	17	14	C	-	C	C	C	11.8	123/124/125/124/125	
	Mar 25	Apr 22	28	100	0	5	N/A	N/A	18	16	17	-	-	C	C	C	11.8	123/123/122/125/124	
I-12	Mar 25	Apr 8	14	100	0	10	10	13	13	13	17	C	C	C	C	C	12.4	125/123/124/122/122	
	Mar 25	Apr 22	28	100	0	10	14	N/A	15	17	13	C	-	C	C	C	12.4	126/123/123/121/122	

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

M I N E B A C K F I L L T E S T R E S U L T S

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. 8714270

Client: WATTS

Location =====>INCO

Date of Report: October 20, 1987

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Slag	Binder Composition (%) Type 10 Portland	Lime	Compressive Strength (p.s.i.)					Type of Fracture					pH of Mix	Unit Weight of Cylinder (pcf)	Remarks
1	May 6	May 20	14	0	100	0	66	73	68	60	52	C	C	C	C	C	12.4	124/120/124/118/122	
	May 6	June 3	28	0	100	0	70	75	77	99	111	C	C	C	C	C	12.4	122/123/123/124/124	
1-14	May 6	May 20	14	0	100	0	14	22	28	22	23	C	C	C	C	C	12.2	125/123/121/125/125	
	May 6	June 3	28	0	100	0	34	45	44	32	32	C	C	C	C	C	12.2	122/122/123/123/124	
1-15	May 6	May 20	14	0	100	0	14	12	16	16	16	C	C	C	C	C	12.0	125/124/125/124/124	
	May 6	June 3	28	0	100	0	20	24	21	19	24	C	C	C	C	C	12.0	125/126/124/124/124	

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

HEMLO GOLD

MINE BACKFILL TEST RESULTS

Job No. => S871427R

Client: Watts Cement

Mine Location =====> Hemlo

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump	Mix Type	Compressive Strength (p.s.i.)	
H-1	June 10	July 8	28	100	0	0				178	
	June 10	July 8	28	100	0	0				244	
	June 10	July 8	28	100	0	0				207	
	June 10	Aug 5	56	100	0	0				213	
	June 10	Aug 5	56	100	0	0				196	
	June 10	Aug 5	56	100	0	0				197	
	June 10	Sept 3	85	100	0	0				233	
	June 10	Sept 3	85	100	0	0				307	
	June 10	Sept 3	85	100	0	0				269	
H-2	June 10	July 8	28	75	25	0				134	
	June 10	July 8	28	75	25	0				176	
	June 10	July 8	28	75	25	0				255	
	June 10	Aug 5	56	75	25	0				173	
	June 10	Aug 5	56	;75	25	0				144	
	June 10	Aug 5	56	75	25	0				171	
	June 10	Sept 3	85	75	25	0				111	
	June 10	Sept 3	85	75	25	0				108	
	June 10	Sept 3	85	75	25	0				108	

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

I L L T E S T R E S U L T S

TROW ONTARIO LTD.
CONSULTING ENGINEERS

atts Cement

Report Date: Oct 20/87

%) Slump	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
		178		8.6	127
		244		8.6	129
		207		8.6	126
		213		8.6	127
		196		8.6	127
		197		8.6	126
		233		8.6	124
		307		8.6	126
		269		8.6	126
		134		11.0	123
		176		11.0	125
		255		11.0	127
		173		11.0	126
		144		11.0	123
		171		11.0	126
		111		11.0	121
		108		11.0	120
		108		11.0	120

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => 5871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Hemlo

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
H-3	June 10	July 8	28	50	50	0				200		11.3	128
	June 10	July 8	28	50	50	0				180		11.3	129
	June 10	July 8	28	50	50	0				181		11.3	130
	June 10	Aug 5	56	50	50	0				218		11.3	127
	June 10	Aug 5	56	50	50	0				218		11.3	125
	June 10	Aug 5	56	50	50	0				221		11.3	126
	June 10	Sept 3	85	50	50	0				161		11.3	123
	June 10	Sept 3	85	50	50	0				217		11.3	126
	June 10	Sept 3	85	50	50	0				179		11.3	122
H-4	June 10	July 8	28	0	100	0				228		11.4	128
	June 10	July 8	28	0	100	0				212		11.4	126
	June 10	July 8	28	0	100	0				223		11.4	126
	June 10	Aug 5	56	0	100	0				137		11.4	122
	June 10	Aug 5	56	0	100	0				339		11.4	129
	June 10	Aug 5	56	0	100	0				166		11.4	125
	June 10	Sept 3	85	0	100	0				206		11.4	125
	June 10	Sept 3	85	0	100	0				154		11.4	124
	June 10	Sept 3	85	0	100	0				220		11.4	124

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Hemlo

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
H-5	June 10	July 8	28	100	0	1				220		10.7	127
	June 10	July 8	28	100	0	1				197		10.7	126
	June 10	July 8	28	100	0	1				216		10.7	126
	June 10	Aug 5	56	100	0	1				215		10.7	126
	June 10	Aug 5	56	100	0	1				90.5		10.7	120
	June 10	Aug 5	56	100	0	1				85		10.7	122
	June 10	Sept 3	85	100	0	1				141		10.7	123
	June 10	Sept 3	85	100	0	1				118		10.7	124
	June 10	Sept 3	85	100	0	1				94		10.7	123
H-6	June 10	July 8	28	100	0	5				115		11.6	128
	June 10	July 8	28	100	0	5				150		11.6	130
	June 10	July 8	28	100	0	5				169		11.6	127
	June 10	Aug 5	56	100	0	5				114		11.6	126
	June 10	Aug 5	56	100	0	5				100		11.6	126
	June 10	Aug 5	56	100	0	5				129		11.6	127
	June 10	Sept 3	85	100	0	5				108		11.6	124
	June 10	Sept 3	85	100	0	5				103		11.6	123
	June 10	Sept 3	85	100	0	5				99		11.6	124

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Hemlo

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
H-7	June 10	July 8	28	100	0	10				213		11.3	125
	June 10	July 8	28	100	0	10				189		11.3	125
	June 10	July 8	28	100	0	10				161		11.3	125
	June 10	Aug 5	56	100	0	10				213		11.3	128
	June 10	Aug 5	56	100	0	10				247		11.3	127
	June 10	Aug 5	56	100	0	10				137		11.3	126
	June 10	Sept 3	85	100	0	10				142		11.3	129
	June 10	Sept 3	85	100	0	10				157		11.3	128
	June 10	Sept 3	85	100	0	10				165		11.3	129
H-8	June 10	July 8	28	100	0	0				158		10.1	125
	June 10	July 8	28	100	0	0				131		10.1	131
	June 10	July 8	28	100	0	0				211		10.1	129
	June 10	Aug 5	56	100	0	0				254		10.1	132
	June 10	Aug 5	56	100	0	0				169		10.1	129
	June 10	Aug 5	56	100	0	0				177		10.1	130
	June 10	Sept 3	85	100	0	0				221		10.1	128
	June 10	Sept 3	85	100	0	0				226		10.1	127
	June 10	Sept 3	85	100	0	0				206		10.1	126

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S8714272

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Hemlo

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Slag %	Binder composition (%) Type 10 Portland	Lime %	Air %	Slump	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
H-9	June 10	July 8	28	75	25	0				186		11.2	126
	June 10	July 8	28	75	25	0				132		11.2	126
	June 10	July 8	28	75	25	0				157		11.2	125
	June 10	Aug 5	56	75	25	0				N/A		11.2	-
	June 10	Aug 5	56	75	25	0				174		11.2	134
	June 10	Sept 3	85	75	25	0				N/A		11.2	-
	June 10	Sept 3	85	75	25	10				N/A		11.2	-
	June 10	Sept 3	85	75	25	10				N/A		11.2	-
H-10	June 10	July 8	28	50	50	0				199		11.3	124
	June 10	July 8	28	50	50	0				159		11.3	129
	June 10	July 8	28	50	50	0				226		11.3	126
	June 10	Aug 5	56	50	50	0				230		11.3	125
	June 10	Aug 5	56	50	50	0				233		11.3	132
	June 10	Aug 5	56	50	50	0				198		11.3	130
	June 10	Sept 3	85	50	50	0				169		11.3	123
	June 10	Sept 3	85	50	50	0				121		11.3	123
	June 10	Sept 3	85	50	50	0				139		11.3	128

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Hemlo

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
H-11	June 10	July 8	28	0	100	0				134		11.5	123
	June 10	July 8	28	0	100	0				116		11.5	122
	June 10	July 8	28	0	100	0				110		11.5	122
	June 10	Aug 5	56	0	100	0				116		11.5	132
	June 10	Aug 5	56	0	100	0				132		11.5	122
	June 10	Aug 5	56	0	100	0				121		11.5	122
	June 10	Sept 3	85	0	100	0				117		11.5	126
	June 10	Sept 3	85	0	100	0				134		11.5	122
	June 10	Sept 3	85	0	100	0				110		11.5	124
H-12	June 10	July 8	28	100	0	1				111		10.3	122
	June 10	July 8	28	100	0	1				103		10.3	123
	June 10	July 8	28	100	0	1				125		10.3	123
	June 10	Aug 5	56	100	0	1				159		10.3	122
	June 10	Aug 5	56	100	0	1				207		10.3	133
	June 10	Aug 5	56	100	0	1				125		10.3	123
	June 10	Sept 3	85	100	0	1				148		10.3	130
	June 10	Sept 3	85	100	0	1				216		10.3	130
	June 10	Sept 3	85	100	0	1				222		10.3	129

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427P

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Hemlo

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder composition (%) Slag %	Type 10 %	Lime %	Air %	Slump	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
H-13	June 11	July 9	28	100	0	5				115		11.3	128
	June 11	July 9	28	100	0	5				113		11.3	123
	June 11	July 9	28	100	0	5				119		11.3	124
	June 11	Aug 6	56	100	0	5				124		11.3	123
	June 11	Aug 6	56	100	0	5				142		11.3	112
	June 11	Aug 6	56	100	0	5				155		11.3	134
	June 11	Sept 4	85	100	0	5				101		11.3	124
	June 11	Sept 4	85	100	0	5				98		11.3	126
	June 11	Sept 4	85	100	0	5				93		11.3	129
H-14	June 11	July 9	28	100	0	10				102		11.3	127
	June 11	July 9	28	100	0	10				118		11.3	127
	June 11	July 9	28	100	0	10				116		11.3	125
	June 11	Aug 6	56	100	0	10				85		11.3	125
	June 11	Aug 6	56	100	0	10				91		11.3	121
	June 11	Aug 6	56	100	0	10				88		11.3	128
	June 11	Sept 4	85	100	0	10				103		11.3	125
	June 11	Sept 4	85	100	0	10				99		11.3	127
	June 11	Sept 4	85	100	0	10				90		11.3	128

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

Trow

TECK CORONA

MINE BACKFILL TEST RESULTS

Job No. = 9814.7P

Client: Watts Cement

Mine Location ====> Teck Corona

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Slag %	Binder composition (%) Type 10 Portland	Lime %	Perc. g	Slump	Mix Type	Compressive Strength (p.s.i)			Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
T-1	June 17	June 24	7	100	0	0	1.48			300	326	324		11.1	130/138/131
	June 17	July 15	28	100	0	0	1.48			340	341	355		11.1	137/136/132
	June 17	Aug 12	56	100	0	0	1.48			389	391	361		11.1	137/131/132
	June 17	Sept 15	90	100	0	0	1.48			460	471	348		11.1	128/131/126
T-2	July 8	July 15	7	0	100	0	1.48			73	111	181		12.4	135/137/137
	July 8	Aug 5	28	0	100	0	1.48			237	297	176		12.4	136/140/137
	July 8	Sept 2	56	0	100	0	1.48			90	48	96		12.4	136/134/132
	July 8	Oct 6	90	0	100	0	1.48			638	703	280		12.4	120/124/131
T-3	July 8	July 15	7	100	0	0	1.48			6	N/A	25		10.4	127/N/A/129
	July 8	Aug 5	28	100	0	0	1.48			155	169	150		10.4	137/133/137
	July 8	Sept 2	56	100	0	0	1.48			127	144	132		10.4	137/134/130
	July 8	Oct 6	90	100	0	0	1.48			177	207	196		10.4	121/131/130

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

DEAN ONTARIO LTD.
CONSULTING ENGINEERS

Job No. 83/14.2P

Client: Watts Cement

Report Date: Oct 14/83

Mine Location =====> Teck Corona

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder composition (%) Slag %	Type 10 Portland	Lime %	Bind. Cont.	Slump	Mix Type	Compressive Strength (p.s.i)			Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
T-4	Aug 11	Aug 20	7	0	100	0	1/10			141	144	122		11.3	132/133/131
	Aug 11	Sept 10	28	0	100	0	1/10			243	219	229		11.3	135/137/133
	Aug 13	Oct 8	56	0	100	0	1/10			386	407	378		11.3	130/130/125
	Aug 13	Nov 11	90	0	100	0	1/10			345	330	330		11.3	136/135/134
T-5	Aug 13	Aug 20	7	100	0	0	1/20			3.8	4.8	4.8		8.4	136/132/129 Saturated
	Aug 13	Sept 10	28	100	0	0	1/20			225	197	216		8.4	138/137/138
	Aug 13	Oct 8	56	100	0	0	1/20			254	264	268		8.4	130/131/124
	Aug 13	Nov 11	90	100	0	0	1/20			250	260	251		8.4	136/137/136
T-6	Aug 14	Aug 21	7	0	100	0	1/20			30	29	53		11.0	126/129/126
	Aug 14	Sept 11	28	0	100	0	1/20			43	N/A	75		11.0	128/129/129
	Aug 14	Oct 9	56	0	100	0	1/20			N/A	100	82		11.0	134/123/126
	Aug 14	Nov 12	90	0	100	0	1/20			69	57	64		11.0	123/125/123
T-7	Aug 14	Aug 31	17	100	0	0	1/30			N/A	N/A	N/A		11.0	Could not be tested
	Aug 14	Sept 11	28	100	0	0	1/30			70	63	66		11.0	127/127/127
	Aug 14	Oct 9	56	100	0	0	1/30			104	127	102		11.0	119/123/126
	Aug 14	Nov 12	90	100	0	0	1/30			102	124	110		11.0	129/126/132

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

Job No. => S8714.27R

Client: Watts Cement

Mine Location =====> Teck Corona

TAIGA CONSULTING LTD.
CONSULTING ENGINEERS

Report Date: Oct 14/87

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Slag %	Binder composition (%) Type 10 Portland	Lime %	Bind. Cont.	Slump	Mix Type	Compressive Strength (p.s.i)			Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
I-8	Aug 14	Aug 21	7	0	100	0	1/30			36	39	39		10.8	133/135/130
	Aug 14	Sept 11	28	0	100	0	1/30			49	N/A	73		10.8	136/133/136
	Aug 14	Oct 9	56	0	100	0	1/30			N/A	71	73		10.8	128/127/129
	Aug 14	Nov 12	90	0	100	0	1/30			65	63	79		10.8	128/126/128
I-9	Aug 17	Aug 31	14	100	0	1	1/30			N/A	N/A	N/A		9.8	Could not be tested
	Aug 17	Sept 14	28	100	0	1	1/30			70	78	70		9.8	129/126/130
	Aug 17	Oct 12	56	100	0	1	1/30			96	91	65		9.8	126/127/131
	Aug 17	Nov 15	90	100	0	1	1/30			96	85	75		9.8	132/132/132
I-10	Aug 17	Aug 31	14	100	0	3	1/30			N/A	N/A	N/A		11.1	Could not be tested
	Aug 17	Sept 14	28	100	0	3	1/30			N/A	59	42		11.1	124/126/127
	Aug 17	Oct 12	56	100	0	3	1/30			86	N/A	148		11.1	126/126/124
	Aug 17	Nov 15	90	100	0	3	1/30			150	123	130		11.1	133/140/130
I-11	Aug 18	Sept 1	14	100	0	5	1/30			44	N/A	N/A		11.5	Could not test B & C
	Aug 18	Sept 15	28	100	0	5	1/30			63	50	68		11.5	131/133/125
	Aug 18	Oct 13	56	100	0	5	1/30			80	61	75		11.5	119/130/121
	Aug 18	Nov 16	90	100	0	5	1/30			26	65	64		11.5	130/140/134

LEGEND: N/A denotes cylinders broke prior to testing.
C - denotes conical fracture.

M I N E B A C K F I L L T E S T R E S U L T S

DPUW UNTARIO LTD.
CONSULTING ENGINEERS

Job No.: '88714/P

Client: Watts Cement

Report Date: Oct 14/87

Mine Location ====: Tenk Carma

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Slag %	Binder composition (%) Type 10 Portland	Lime %	Blend. Cont.	Slump	Mix Type	Compressive Strength (p.s.i)			Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
1 A	Aug 10	Sept	14	100	0	7	1/30			19	32	36		11.7	131.1/30.1/33
	Aug 10	Sept 1?	28	100	0	7	1/30			56	32	55		11.7	1?0.1/3a.1.?5
	Aug 10	Oct 13	56	100	0	7	1/30			73	83	N/A		11.7	1?3.121.1?0
	Aug 10	Nov 16	90	100	0	7	1/30			64	71	N/A		11.7	1?.?0

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

Trow

DENISON MINES

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Lab No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Denison Mines

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump (mm)	Mix Type MPa	Compressive Strength (MPa)			Type of Fracture			pH of Mix	Unit Weight of Cylinders (kg/m^3)
D-1	Apr 30	May 7	7	100	0	0	6.3	228	25	9.1	9.5	10.0	C	C	C	11.4	2325/2320/2315
	Apr 30	May 28	28	100	0	0	6.3	228	25	14.0	14.1	14.0	C	C	C	11.4	2300/2310/2315
	Apr 30	June 29	60	100	0	0	6.0	231	25	16.0	14.8	15.4	C	C	C	11.4	2315/2315/2315
	Apr 30	July 29	90	100	0	0	6.0	231	25	16.1	16.3	16.2	C	C	C	11.4	2320/2305/2305
	Apr 30	Aug 28	120	100	0	0	6.0	231	25	17.4	12.3	20.8	C	C	C	11.4	2295/2290/2330
D-2	Apr 30	May 7	7	75	25	0	5.5	228	25	15.2	17.2	17.1	C	C	C	11.7	2325/2335/2335
	Apr 30	May 28	28	75	25	0	5.5	228	25	25.8	26.9	26.2	C	C	C	11.7	2330/2325/2325
	Apr 30	July 3	60	75	25	0	6.0	228	25	33.0	32.3	32.0	C	C	C	11.7	2295/2335/2335
	Apr 30	Aug 2	90	75	25	0	6.0	228	25	33.6	33.9	32.6	C	C	C	11.7	2340/2295/2295
	Apr 30	Sept 1	120	75	25	0	6.0	228	25	32.2	34.6	34.4	C	C	C	11.7	2300/2300/2300
D-3	May 4	May 11	7	50	50	0	6.6	228	25	17.5	17.4	18.1	C	C	C	11.7	2275/2275/2275
	May 4	June 1	28	50	50	0	6.6	228	25	37.2	33.7	35.7	C	C	C	11.7	2280/2285/2280
	May 4	July 3	60	50	50	0	6.6	228	25	41.2	42.2	37.5	C	C	C	11.7	2290/2285/2290
	May 4	Aug 2	90	50	50	0	6.6	228	25	40.9	39.1	40.3	C	C	C	11.7	2280/2285/2290
	May 4	Sept 1	120	50	50	0	6.6	228	25	46.8	46.1	41.1	C	C	C	11.7	2290/2295/2275

LEGEND: N/A denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427P

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Denison Mines

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump (mm)	Mix Type MPa	Compressive Strength (MPa)			Type of Fracture			pH of Mix	Unit Weight of Cylinders (kg/m^3)
D-4	Apr 30	May 7	7	0	100	0	6.0	228	25	28.5	28.6	28.2	C	C	C	12.5	2290/2280/2285
	Apr 30	May 28	28	0	100	0	6.0	228	25	33.6	33.1	32.1	C	C	C	12.5	2310/2305/2310
	Apr 30	June 29	60	0	100	0	6.0	228	25	38.0	32.8	41.3	C	C	C	12.5	2345/2355/2355
	Apr 30	July 29	90	0	100	0	6.0	228	25	36.4	36.2	40.9	C	C	C	12.5	2330/2350/2350
	Apr 30	Aug 28	120	0	100	0	6.0	228	25	38.3	42.7	42.5	C	C	C	12.5	2300/2335/2335
D-5	May 4	May 11	7	100	0	1	6.4	228	25	3.7	3.9	3.8	C	C	C	8.0	2330/2330/2325
	May 4	June 1	28	100	0	1	6.4	228	25	5.8	5.9	6.0	C	C	C	8.0	2265/2290/2275
	May 4	July 3	60	100	0	1	6.4	228	25	7.4	6.3	6.1	C	C	C	8.0	2260/2260/2300
	May 4	Aug 2	90	100	0	1	6.4	228	25	8.3	8.5	8.5	C	C	C	8.0	2310/2295/2310
	May 4	Sept 1	120	100	0	1	6.4	228	25	9.1	8.7	8.9	C	C	C	8.0	2245/2265/2295
D-6	May 8	May 15	7	100	0	3	5.5	228	25	3.6	3.8	3.8	C	C	C	11.5	2230/2245/2210
	May 8	June 5	28	100	0	3	5.5	228	25	5.1	5.1	5.2	C	C	C	11.5	2215/2205/2210
	May 8	July 7	60	100	0	3	5.5	228	25	6.8	4.2	5.8	C	C	C	11.5	2230/2220/2210
	May 8	Aug 6	90	100	0	3	5.5	228	25	7.0	7.2	7.0	C	C	C	11.5	2230/2230/2230
	May 8	Sept 5	120	100	0	3	5.5	228	25	7.5	8.1	7.7	C	C	C	11.5	2230/2250/2235

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical break.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Denison Mines

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump (mm)	Mix Type MPa	Compressive Strength (MPa)			Type of Fracture			pH of Mix	Unit Weight of Cylinders (kg/m^3)
D-7	May 8	May 15	7	100	0	5	6.0	228	25	3.8	3.6	2.0	C	C	C	11.9	2175/2175/2170
	May 8	June 5	28	100	0	5	6.0	228	25	6.5	7.2	6.9	C	C	C	11.9	2180/2235/2235
	May 8	July 7	60	100	0	5	6.0	228	25	8.3	8.9	8.3	C	C	C	11.9	2245/2230/2230
	May 8	Aug 6	90	100	0	5	6.0	228	25	8.7	8.1	8.9	C	C	C	11.9	2230/2235/2220
	May 8	Sept 5	120	100	0	5	6.0	228	25	9.3	9.1	9.9	C	C	C	11.9	2235/2250/2260
D-8	May 11	May 18	7	100	0	0	6.3	254	35	8.1	8.1	8.0	C	C	C	10.7	2080/2090/2100
	May 11	June 8	28	100	0	0	6.3	254	35	12.9	13.5	13.5	C	C	C	10.7	2065/2070/2090
	May 11	July 10	60	100	0	0	6.3	254	35	14.3	14.4	14.4	C	C	C	10.7	2055/2060/2070
	May 11	Aug 9	90	100	0	0	6.3	254	35	15.9	17.4	18.3	C	C	C	10.7	2100/2110/2115
	May 11	Sept 8	120	100	0	0	6.3	254	35	17.9	18.5	18.9	C	C	C	10.7	2100/2105/2100
D-9	May 11	May 18	7	75	25	0	7.0	254	35	10.1	10.1	10.4	C	C	C	11.8	2070/2070/2070
	May 11	June 8	28	75	25	0	7.0	254	35	22.2	24.7	26.2	C	C	C	11.8	2075/2160/2155
	May 11	July 10	60	75	25	0	7.0	254	35	28.6	29.3	29.1	C	C	C	11.8	2165/2170/2170
	May 11	Aug 9	90	75	25	0	7.0	254	35	25.0	25.0	27.5	C	C	C	11.8	2135/2120/2125
	May 11	Sept 8	120	75	25	0	7.0	254	35	29.2	29.9	30.4	C	C	C	11.8	2135/2125/2120

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Denison Mines

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump (mm)	Mix Type MPa	Compressive Strength (MPa)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (kg/m^3)
D-10	May 12	May 19	7	50	50	0	6.5	254	35	16.9 16.7 15.9	C C C	12.1	2045/2050/2055
	May 12	June 9	28	50	50	0	6.5	254	35	40.1 39.8 32.4	C C C	12.1	2120/2125/2060
	May 12	July 11	60	50	50	0	6.5	254	35	44.3 41.8 48.5	C C C	12.1	2135/2130/2205
	May 12	Aug 10	90	50	50	0	6.5	254	35	47.9 49.8 39.8	C C C	12.1	2205/2205/2220
	May 12	Sept 9	120	50	50	0	6.5	254	35	41.7 48.6 45.0	C C C	12.1	2160/2165/2160
D-11	May 12	May 19	7	0	100	0	6.5	254	35	29.4 29.2 26.8	C C C	11.9	2190/2195/2190
	May 12	June 9	28	0	100	0	6.5	254	35	36.4 32.7 34.7	C C C	11.9	2190/2175/2190
	May 12	July 11	60	0	100	0	6.5	254	35	34.5 35.6 36.0	C C C	11.9	2170/2180/2190
	May 12	Aug 10	90	0	100	0	6.5	254	35	38.1 37.5 39.6	C C C	11.9	2205/2220/2190
	May 12	Sept 9	120	0	100	0	6.5	254	35	39.8 39.0 39.8	C C C	11.9	2195/2195/2205
D12	May 12	May 19	7	100	0	1	5.8	254	35	4.1 3.8 3.8	C C C	11.8	2155/2150/2165
	May 12	June 9	28	100	0	1	5.8	254	35	5.8 5.8 5.1	C C C	11.8	2155/2155/2125
	May 12	July 11	60	100	0	1	5.8	254	35	N/A N/A 6.2	C C C	11.8	2025/2070/2160
	May 12	Aug 10	90	100	0	1	5.8	254	35	6.1 6.2 6.7	C C C	11.8	2155/2130/2135
	May 12	Sept 9	120	100	0	1	5.8	254	35	7.3 7.0 6.7	C C C	11.8	2125/2135/2135

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Denison Mines

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Slag %	Binder Composition (%) Type 10 Portland	Lime %	Air %	Slump (mm)	Mix Type MPa	Compressive Strength (MPa)			Type of Fracture			pH of Mix	Unit Weight of Cylinders (kg/m^3)
D-13	May 14	May 21	7	100	0	3	5.8	254	35	4.9	4.8	4.6	C	C	C	11.7	2140/2155/2135
	May 14	June 11	28	100	0	3	5.8	254	35	7.2	7.3	7.1	C	C	C	11.7	2145/2155/2145
	May 14	July 13	60	100	0	3	5.8	254	35	8.7	8.5	8.3	C	C	C	11.7	2160/2150/2155
	May 14	Aug 12	90	100	0	3	5.8	254	35	8.9	9.5	9.4	C	C	C	11.7	2160/2160/2160
	May 14	Sept 11	120	100	0	3	5.8	254	35	9.2	9.1	9.6	C	C	C	11.7	2155/2165/2160
D-14	May 14	May 21	7	100	0	5	5.9	254	35	4.3	4.5	4.5	C	C	C	11.8	2145/2150/2145
	May 14	June 11	28	100	0	5	5.9	254	35	8.1	7.7	8.2	C	C	C	11.8	2155/2135/2140
	May 14	July 13	60	100	0	5	5.9	254	35	10.0	9.4	9.6	C	C	C	11.8	2130/2125/2150
	May 14	Aug 12	90	100	0	5	5.9	254	35	10.8	12.2	10.5	C	C	C	11.8	2135/2150/2145
	May 14	Sept 11	120	100	0	5	5.9	254	35	11.4	11.3	11.5	C	C	C	11.8	2155/2155/2150

LEGEND: N/A - denotes cylinders broke prior to testing.
C - denotes conical fracture.

Trow

LAC MINERALS

MINE BACKFILL TEST RESUL

Job No. =>S871427R

Client : Watts Cement

Mine Location =====>Lac Minerals

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag	Type 10 Portland	Lime	Compressive Strength (p.s.i.)				Type of Fracture			
L - 1	Mar 27	Apr 24	28	100	0	0	313	306	293		C	C	C	
	Mar 27	May 22	56	100	0	0	304	252	342		C	C	C	
	Mar 27	June 20	85	100	0	0	410	350	411		C	C	C	
L - 2	Mar 27	Apr 24	28	75	25	0	430	436	430		C	C	C	
	Mar 27	May 22	56	75	25	0	445	455	466		C	C	C	
	Mar 27	June 20	85	75	25	0	509	484	509		C	C	C	
L - 3	Mar 27	Apr 24	28	50	50	0	452	455	455		C	C	C	
	Mar 27	May 22	56	50	50	0	466	519	477		C	C	C	
	Mar 27	June 20	85	50	50	0	438	422	622		C	C	C	
L - 4	Mar 30	Apr 27	28	0	100	0	424	433	398		C	C	C	
	Mar 30	May 25	56	0	100	0	391	484	429		C	C	C	
	Mar 30	June 23	85	0	100	0	515	407	543		C	C	C	
L - 5	Mar 30	Apr 27	28	100	0	1	376	332	391		C	C	C	
	Mar 30	May 25	56	100	0	1	382	377	414		C	C	C	
	Mar 30	June 23	85	100	0	1	322	356	N/A		C	C	-	

NOTES: N/A - denotes cylinder broke before testing.
C - denotes conical fracture.

BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Client : Watts Cement

Date of Report : October 21, 1987

Compressive Strength (p.s.i.)				Type of Fracture				pH of Mix	Unit Weight of Cylinders (pcf)	Remarks
313	306	293		C	C	C		10.7	138 / 138 / 140	
304	252	342		C	C	C		10.7	141 / 140 / 140	
410	350	411		C	C	C		10.7	138 / 138 / 138	
430	436	430		C	C	C		10.5	135 / 137 / 137	
445	455	466		C	C	C		10.5	137 / 138 / 138	
509	484	509		C	C	C		10.5	138 / 138 / 137	
452	455	455		C	C	C		11.3	138 / 135 / 135	
466	519	477		C	C	C		11.3	135 / 134 / 134	
438	422	622		C	C	C		11.3	135 / 136 / 131	
424	433	398		C	C	C		11.4	141 / 142 / 142	
391	484	429		C	C	C		11.4	140 / 139 / 139	
515	407	543		C	C	C		11.4	139 / 140 / 140	
376	332	391		C	C	C		11.9	139 / 138 / 139	
382	377	414		C	C	C		11.9	139 / 137 / 137	
322	356	N/A		C	C	-		11.9	136 / 136 / 137	

MINE BACKFILL TEST

Job No. =>S871427R

Client : Watts Cement

Mine Location =====>Lac Minerals

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%): Slag	Type 10 Portland	Lime	Compressive Strength (p.s.i.)					T F
L - 6	Mar 30	Apr 27	28	100	0	5	357	333	336		C	C
	Mar 30	May 25	56	100	0	5	349	358	348		C	C
	Mar 30	June 23	85	100	0	5	333	402	396		C	C
L - 7	Mar 31	Apr 28	28	100	0	10	230	206	213		C	C
	Mar 31	May 26	56	100	0	10	446	470	359		C	C
	Mar 31	June 24	85	100	0	10	463	553	403		C	C
L - 8	Mar 31	Apr 28	28	100	0	0	230	206	213		C	C
	Mar 31	May 26	56	100	0	0	294	311	241		C	C
	Mar 31	June 24	85	100	0	0	385	198	236		C	C
L - 9	Mar 30	Apr 28	28	75	25	0	285	442	362		C	C
	Mar 30	May 26	56	75	25	0	345	459	333		C	C
	Mar 30	June 24	85	75	25	0	405	490	342		C	C
L - 10	Mar 30	Apr 28	28	50	50	0	431	332	456		C	C
	Mar 30	May 26	56	50	50	0	357	401	476		C	C
	Mar 30	June 24	85	50	50	0	557	389	439		C	C

LEGEND: N/A - denotes cylinders broke before testing.
C - denotes conical fracture.

NE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Client : Watts Cement

Date of Report :October 21, 1987

(%) me	Compressive Strength (p.s.i.)			Type of Fracture			pH of Mix	Unit Weight of Cylinders (pcf)	Remarks
5	357	333	336	C	C	C	12.1	142 / 143 / 142	
5	349	358	348	C	C	C	12.1	140 / 141 / 141	
5	333	402	396	C	C	C	12.1	140 / 139 / 143	
10	230	206	213	C	C	C	12.8	133 / 143 / 139	
10	446	470	359	C	C	C	12.8	139 / 138 / 135	
10	463	553	403	C	C	C	12.8	139 / 136 / 137	
0	230	206	213	C	C	C	11.2	130 / 130 / 131	
0	294	311	241	C	C	C	11.2	132 / 131 / 133	
0	385	198	236	C	C	C	11.2	132 / 134 / 135	
0	285	442	362	C	C	C	11.0	137 / 139 / 138	
0	345	459	333	C	C	C	11.0	138 / 138 / 136	
0	405	490	342	C	C	C	11.0	137 / 136 / 137	
0	431	332	456	C	C	C	11.8	132 / 126 / 134	
0	357	401	476	C	C	C	11.8	130 / 130 / 134	
0	557	389	439	C	C	C	11.8	132 / 134 / 134	

MINE BACKFILL TEST RES

Job No. =>S871427R

Client : Watts Cement

Mine Location =====>Lac Minerals

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag	Type 10 Portland	Lime	Compressive Strength (p.s.i.)			Type of Fracture		
L - 11	Apr 1	Apr 29	28	0	100	0	438	356	337	C	C	C
	Apr 1	May 27	56	0	100	0	325	308	243	C	C	C
	Apr 1	June 25	85	0	100	0	396	330	531	C	C	C
L - 12	Apr 1	Apr 29	28	100	0	1	331	330	421	C	C	C
	Apr 1	May 27	56	100	0	1	372	309	288	C	C	C
	Apr 1	June 25	85	100	0	1	326	304	263	C	C	C
L - 13	Apr 1	Apr 29	28	100	0	5	238	298	349	C	C	C
	Apr 1	May 27	56	100	0	5	225	150	274	C	C	C
	Apr 1	June 25	85	100	0	5	205	432	402	C	C	C
L - 14	Apr 1	Apr 29	28	100	0	10	216	318	213	C	C	C
	Apr 1	May 27	56	100	0	10	191	371	343	C	C	C
	Apr 1	June 25	85	100	0	10	301	393	492	C	C	C

LEGEND: N/A - denotes cylinders broke before testing.
C - denotes conical fracture.

B A C K F I L L T E S T R E S U L T S

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Client : Watts Cement

Date of Report :October 21, 1987

Compressive Strength (p.s.i.)				Type of Fracture				pH of Mix	Unit Weight of Cylinders (pcf)	Remarks
438	356	337		C	C	C		11.4	142 / 141 / 144	
825	308	243		C	C	C		11.4	143 / 145 / 138	
896	330	531		C	C	C		11.4	141 / 145 / 145	
831	330	421		C	C	C		11.8	137 / 142 / 136	
872	309	288		C	C	C		11.8	144 / 139 / 141	
826	304	263		C	C	C		11.8	141 / 140 / 143	
238	298	349		C	C	C		12.0	133 / 141 / 140	
225	150	274		C	C	C		12.0	135 / 129 / 139	
205	432	402		C	C	C		12.0	147 / 146 / 144	
216	318	213		C	C	C		11.8	133 / 138 / 126	
191	371	343		C	C	C		11.8	131 / 138 / 138	
801	393	492		C	C	C		11.8	140 / 140 / 145	

DETOUR LAKE

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Detour Lake Mine

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump (in.)	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
DL-1	June 11	June 18	7	100	0	0				20.0	C	10.4	124
	June 11	June 18	7	100	0	0				14.0	C	10.4	124
	June 11	June 18	7	100	0	0				20.0	C	10.4	123
	June 11	July 9	28	100	0	0				68.0	C	10.4	137
	June 11	July 9	28	100	0	0				108	C	10.4	133
	June 11	July 9	28	100	0	0				108	C	10.4	133
DL-2	June 11	June 18	7	75	25	0				27.0	C	12.0	124
	June 11	June 18	7	75	25	0				22.0	C	12.0	123
	June 11	June 18	7	75	25	0				22.0	C	12.0	124
	June 11	July 9	28	75	25	0				101	C	12.0	134
	June 11	July 9	28	75	25	0				102	C	12.0	135
	June 11	July 9	28	75	25	0				94.0	C	12.0	142
DL-3	June 11	June 18	7	0	100	0				61.0	C	12.3	126
	June 11	June 18	7	0	100	0				66.0	C	12.3	125
	June 11	June 18	7	0	100	0				52.0	C	12.3	124
	June 11	July 9	28	0	100	0				109	C	12.3	132
	June 11	July 9	28	0	100	0				96.0	C	12.3	131
	June 11	July 9	28	0	100	0				70.0	C	12.3	133

LEGEND: N/A - denotes cylinders broke before testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => 5871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Detour Lake Mine

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Slag %	Binder Composition (%) Type 10 Portland	Lime %	Air %	Slump (in.)	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
DL-4	June 11	June 18	7	100	0	1				53.0	C	11.9	126
	June 11	June 18	7	100	0	1				58.0	C	11.9	125
	June 11	June 18	7	100	0	1				38.0	C	11.9	125
	June 11	July 9	28	100	0	1				50.0	C	11.9	129
	June 11	July 9	28	100	0	1				63.0	C	11.9	130
	June 11	July 9	28	100	0	1				53.0	C	11.9	127
DL-5	June 11	June 18	7	100	0	3				30.0	C	11.9	125
	June 11	June 18	7	100	0	3				21.0	C	11.9	124
	June 11	June 18	7	100	0	3				6.0	C	11.9	122
	June 11	July 9	28	100	0	3				65.0	C	11.9	124
	June 11	July 9	28	100	0	3				61.0	C	11.9	132
	June 11	July 9	28	100	0	3				59.0	C	11.9	130
DL-6	June 12	June 19	7	100	0	5				15.0	C	12.2	132
	June 12	June 19	7	100	0	5				19.0	C	12.2	130
	June 12	June 19	7	100	0	5				28.0	C	12.2	129
	June 12	July 10	28	100	0	5				48.0	C	12.2	133
	June 12	July 10	28	100	0	5				43.0	C	12.2	132
	June 12	July 10	28	100	0	5				39.0	C	12.2	130

LEGEND: N/A - denotes cylinders broke before testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Detour Lake Mine

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Binder Composition (%) Slag %	Type 10 Portland	Lime %	Air %	Slump (in.)	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
DL-7	June 12	June 19	7	100	0	0				N/A		10.1	-
	June 12	June 19	7	100	0	0				N/A		10.1	-
	June 12	June 19	7	100	0	0				N/A		10.1	-
	June 12	July 10	28	100	0	0				74.0	C	10.1	130
	June 12	July 10	28	100	0	0				55.0	C	10.1	130
	June 12	July 10	28	100	0	0				59.0	C	10.1	123
DL-8	June 12	June 19	7	75	25	0				23.0	C	11.6	130
	June 12	June 19	7	75	25	0				16.0	C	11.6	132
	June 12	June 19	7	75	25	0				8.0	C	11.6	124
	June 12	July 10	28	75	25	0				47.0	C	11.6	131
	June 12	July 10	28	75	25	0				73.0	C	11.6	132
	June 12	July 10	28	75	25	0				55.0	C	11.6	124
DL-9	June 15	June 22	7	0	100	0				27.0	C	12.1	130
	June 15	June 22	7	0	100	0				27.0	C	12.1	134
	June 15	June 22	7	0	100	0				25.0	C	12.1	133
	June 15	July 13	28	0	100	0				36.0	C	12.1	131
	June 15	July 13	28	0	100	0				39.0	C	12.1	134
	June 15	July 13	28	0	100	0				39.0	C	12.1	133

LEGEND: N/A - denotes cylinders broke before testing.
C - denotes conical fracture.

MINE BACKFILL TEST RESULTS

TROW ONTARIO LTD.
CONSULTING ENGINEERS

Job No. => S871427R

Client: Watts Cement

Report Date: Oct 20/87

Mine Location =====> Detour Lake Mine

Cylinder No.	Date Cast	Date Tested	Curing Time (days)	Slag %	Binder Composition (%) Type 10 Portland	Lime %	Air %	Slump (in.)	Mix Type	Compressive Strength (p.s.i)	Type of Fracture	pH of Mix	Unit Weight of Cylinders (pcf)
DL-10	June 15	June 22	7	100	0	1				N/A	-	10.7	-
	June 15	June 22	7	100	0	1				N/A	-	10.7	-
	June 15	June 22	7	100	0	1				N/A	-	10.7	-
	June 15	July 13	28	100	0	1				30.0	C	10.7	131
	June 15	July 13	28	100	0	1				48.0	C	10.7	134
	June 15	July 13	28	100	0	1				47.0	C	10.7	133
DL-11	June 15	June 22	7	100	0	3				19.0	C	11.4	133
	June 15	June 22	7	100	0	3				15.0	C	11.4	133
	June 15	June 22	7	100	0	3				N/A	-	11.4	-
	June 15	July 13	28	100	0	3				48.0	C	11.4	129
	June 15	July 13	28	100	0	3				46.0	C	11.4	130
	June 15	July 13	28	100	0	3				55.0	C	11.4	132
DL-12	June 15	June 22	7	100	0	5				32.0	C	12.1	132
	June 15	June 22	7	100	0	5				33.0	C	12.1	133
	June 15	June 22	7	100	0	5				32.0	C	12.1	133
	June 15	July 13	28	100	0	5				52.0	C	12.1	127
	June 15	July 13	28	100	0	5				N/A	-	12.1	128
	June 15	July 13	28	100	0	5				39.0	C	12.1	129

LEGEND: N/A - denotes cylinders broke before testing.
C - denotes conical fracture.

Trow

APPENDIX 2

S871427R

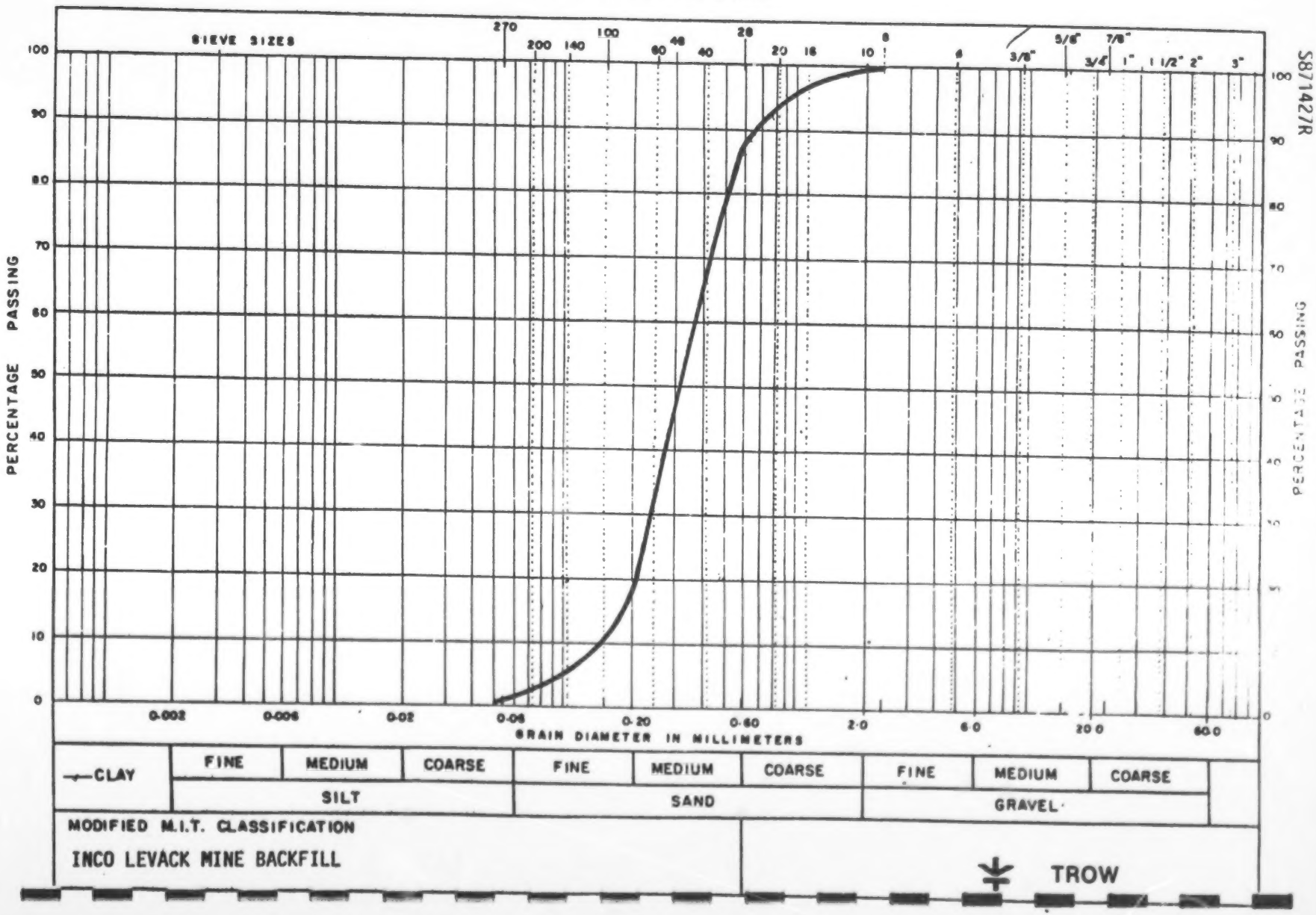
Trow

SUMMARY OF LABORATORY TESTING
TECK - CORONA MINE BACKFILL

	SAND	TAILINGS	30% TAILING 70% SAND
Dry Rodded Density	117.1 lbs/ft³ 1875 kg/m³	86.9 lbs/ft³ 1392 kg/m³	109.0 lbs/ft³ 1746 kg/m³
Bulk Relative Density	2.71	2.86	2.93
Apparent Relative Density	2.92	2.94	2.98
Absorption	4.17%	1.42%	0.81%

Permeability rate found to be 7.7 cm/hr.

MECHANICAL ANALYSIS



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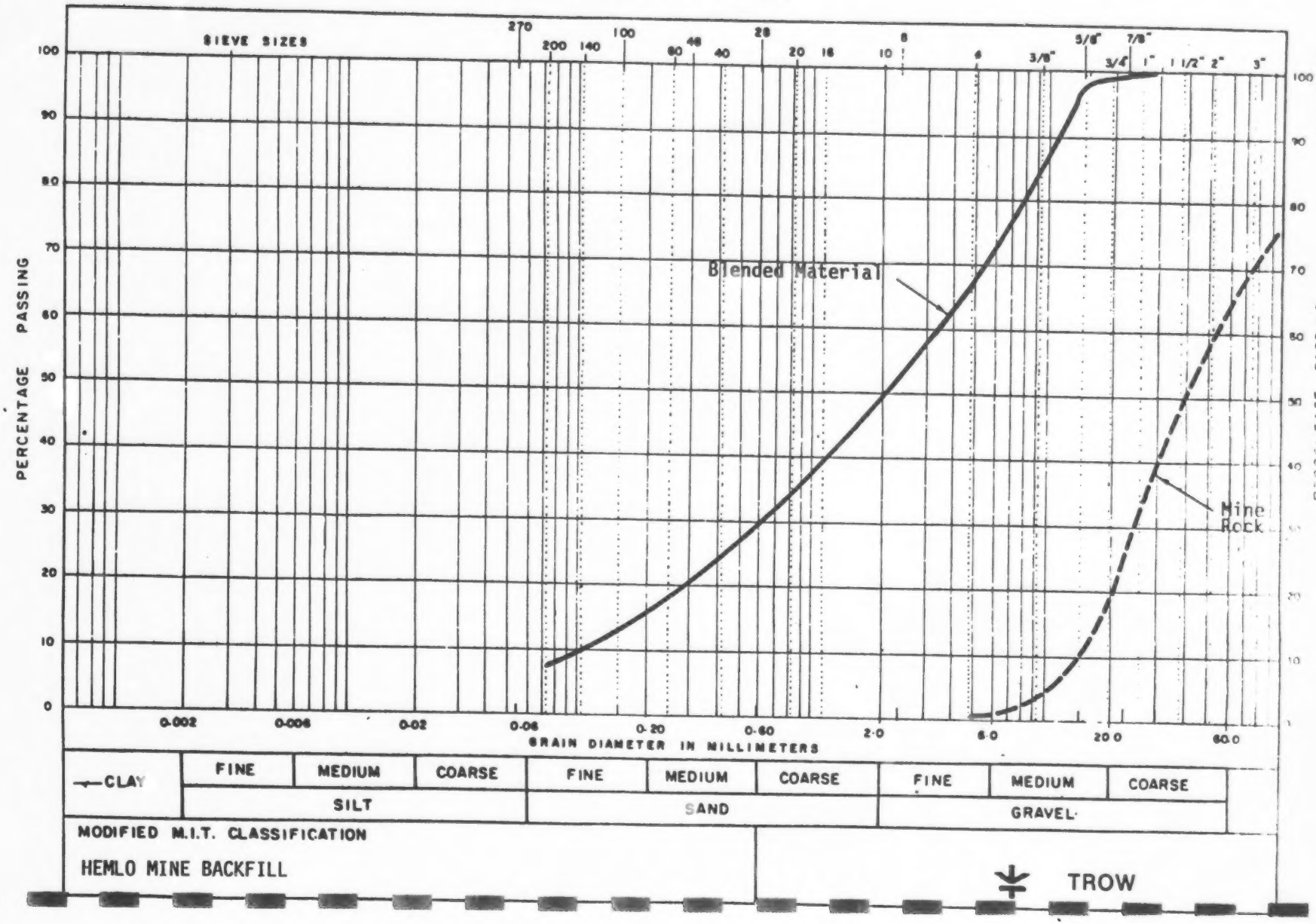
MECHANICAL ANALYSIS



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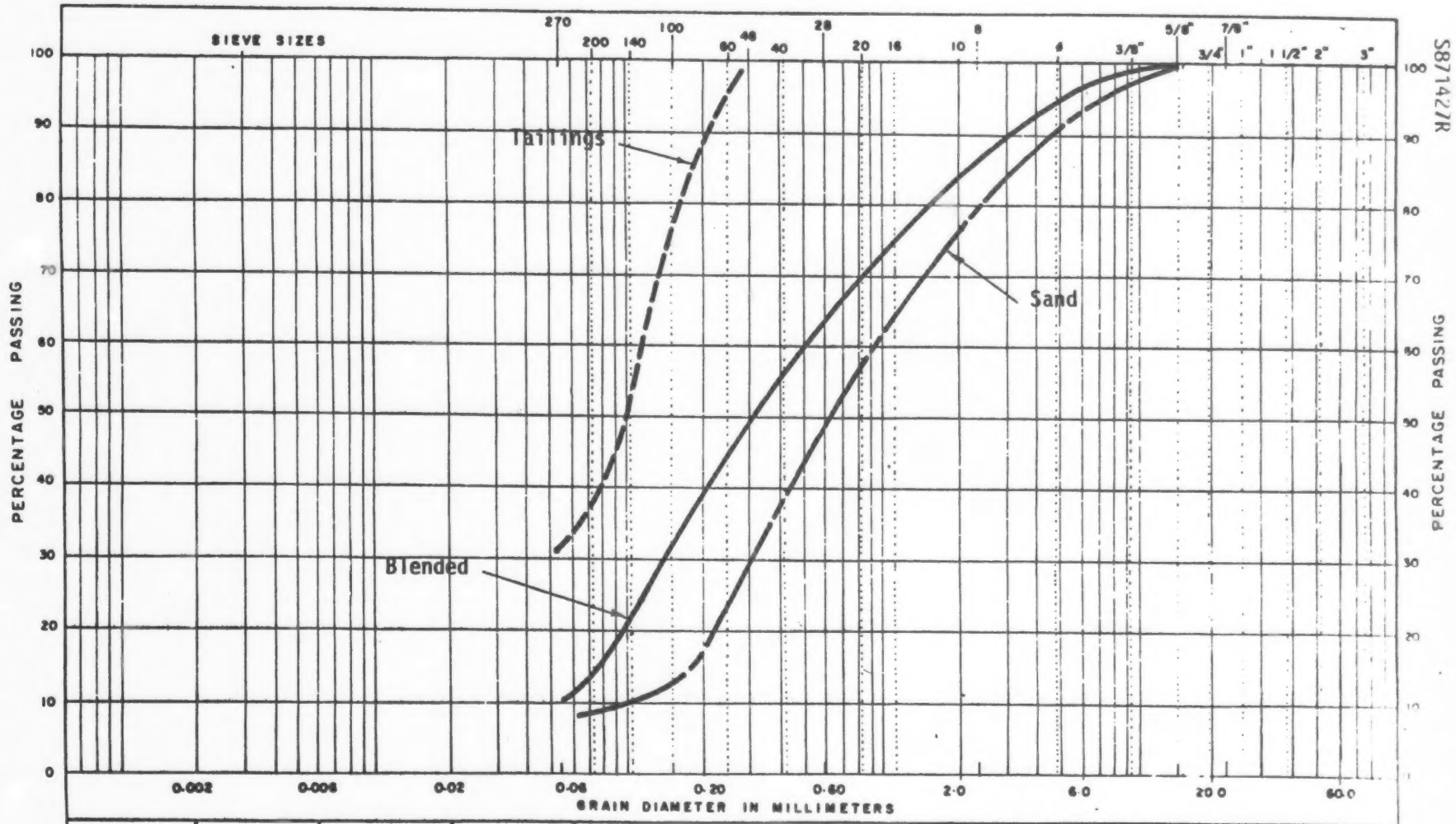

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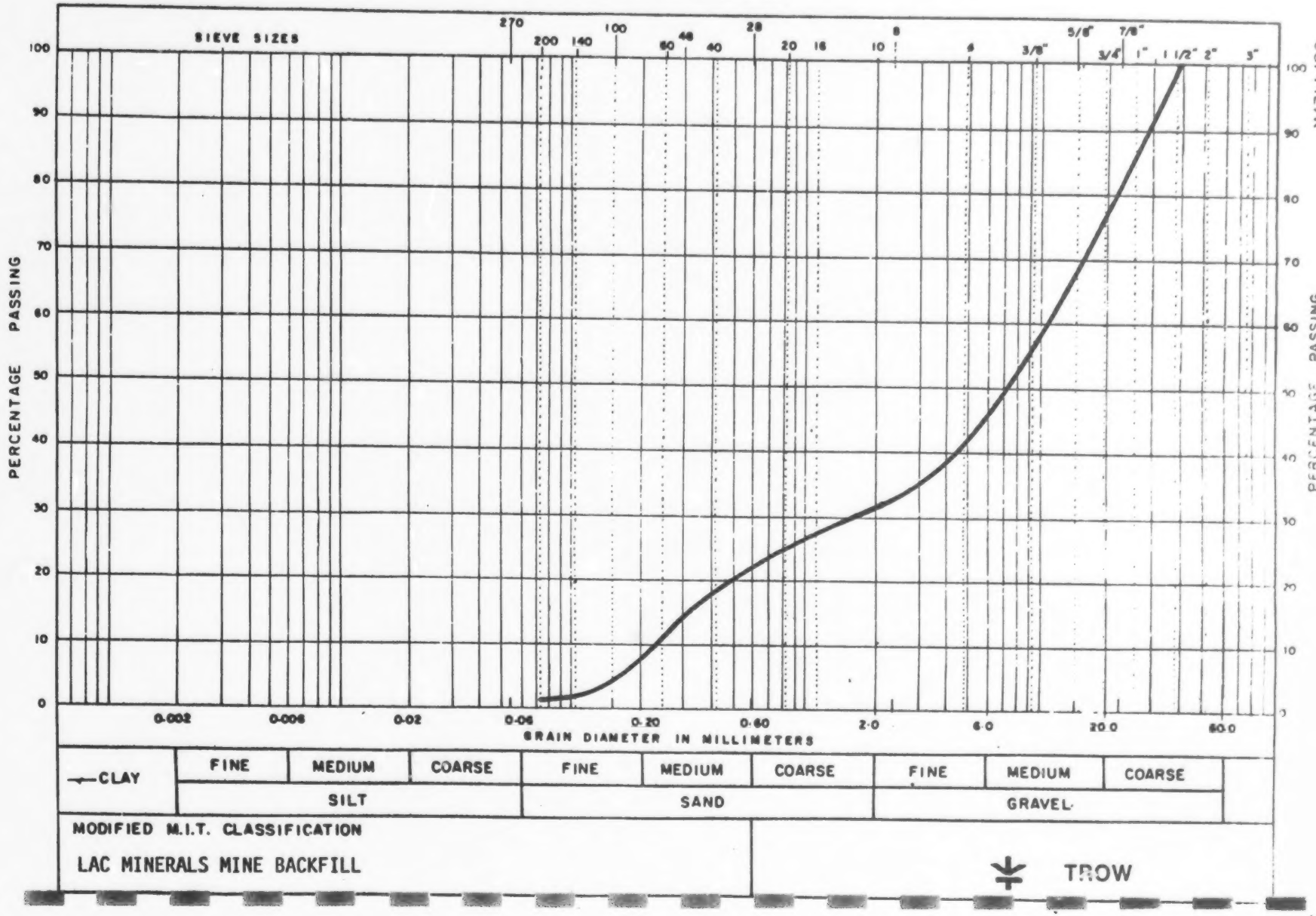
MODIFIED M.I.T. CLASSIFICATION

TECK CORONA MINE BACKFILL

TROW

MECHANICAL ANALYSIS



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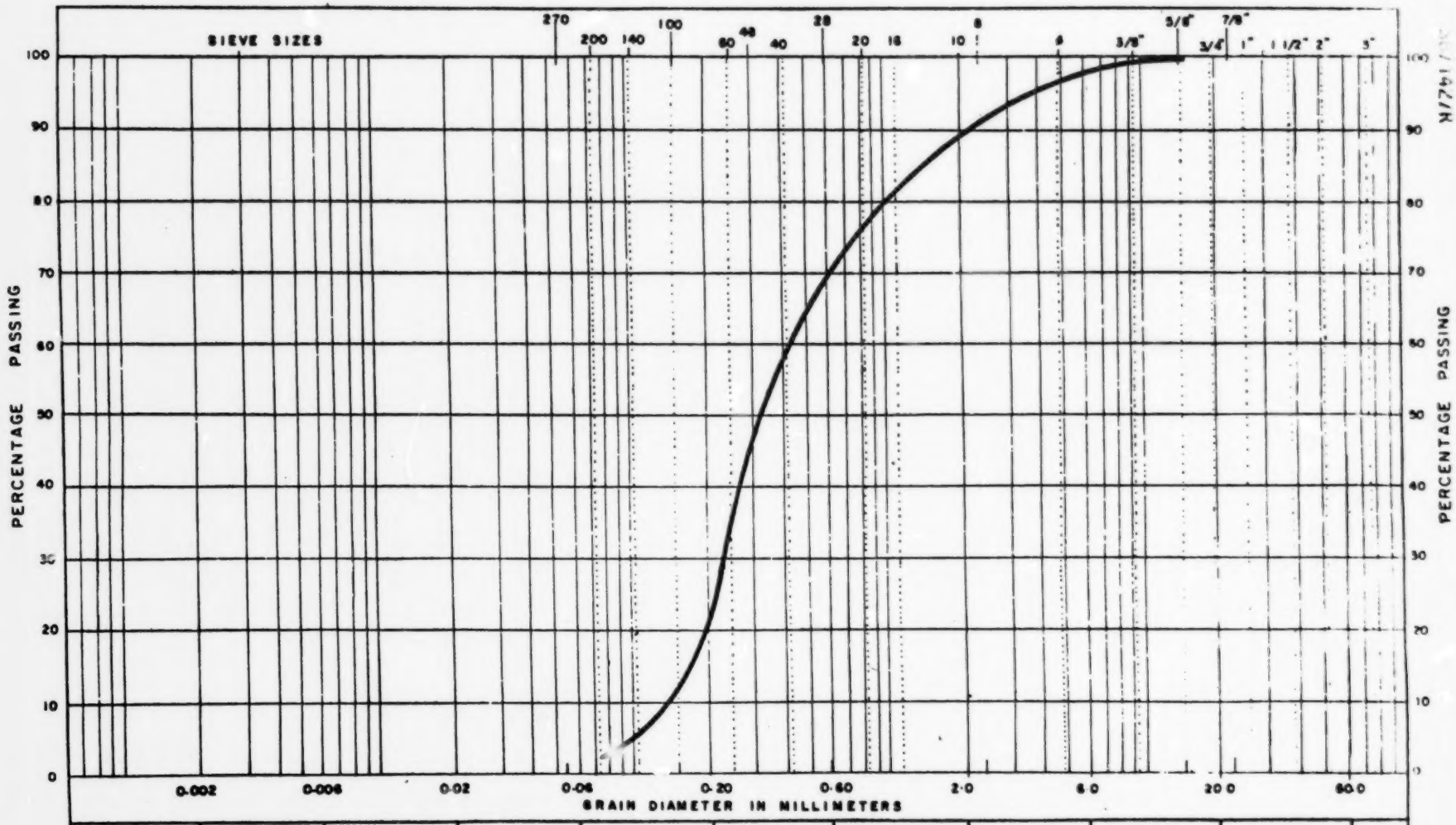
MECHANICAL ANALYSIS



MODIFIED M.I.T. CLASSIFICATION

DETOUR LAKE MINE BACKFILL

TROW

5.0 CONCLUSIONS

5.0 CONCLUSIONS

On the basis of the results of the tests conducted to evaluate slag cement for possible replacement of Portland cement in mine backfill, the following conclusions are drawn:

1. Ground granulated blast furnace slag performed well enough at all mines to warrant further investigation of its use.

2. Evaluation of GGBFS should be continued in the form of underground tests at the participating mining companies.